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FORM PTO-1390 (REV. 5-93)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	CASE NO. 9683/81
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371			U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) 09/786560
INTERNATIONAL APPLICATION NO. PCT/JP00/05241	INTERNATIONAL FILING DATE August 4, 2000	PRIORITY DATE CLAIMED August 6, 1999	
TITLE OF INVENTION ELECTRONIC DEVICE WITH USB INTERFACE			
APPLICANT(S) FOR DO/EO/US Hideo Uchizono and Seiji Abe			
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:			
<ol style="list-style-type: none">1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 3712. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 3713. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).4. <input type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)).<ol style="list-style-type: none">a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).b. <input type="checkbox"/> has been transmitted by the International Bureau.c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).<ol style="list-style-type: none">a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).b. <input type="checkbox"/> have been transmitted by the International Bureau.c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.d. <input checked="" type="checkbox"/> have not been made and will not be made.8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)) and/or amendments under Article 34.			
Items 11. to 16. Below concern other document(s) or information included:			
<ol style="list-style-type: none">11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet (in duplicate) in compliance with 37 CFR 3.28 and 3.31 is included.13. <input checked="" type="checkbox"/> A FIRST preliminary amendment. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.14. <input type="checkbox"/> A substitute specification.15. <input checked="" type="checkbox"/> A change of power of attorney and/or address letter.16. <input checked="" type="checkbox"/> Other items or information: Copy of Request (Form PCT/RO/101), Copy of Form PCT/IB/301, Copy of Form PCT/IB/308, Copy of International Publication WO 01/11475 A1, and Return Postcard.			

U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.50) 09/786580		INTERNATIONAL APPLICATION NO. PCT/JP00/05241		CASE NO. 9683/81			
17. <input type="checkbox"/> The following fees are submitted: Basic National Fee (37 CFR 1.492(a)(1)-(5)): Search Report has been prepared by the EPO or JPO..... \$860.00 International preliminary examination fee paid to USPTO (37 CFR 1.492(a)(1))..... \$690.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.492(a)(2))..... \$710.00 Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.492(a)(3)) paid to USPTO..... \$1,000.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)..... \$100.00 <div style="text-align: center;">ENTER APPROPRIATE BASIC FEE AMOUNT</div>				CALCULATIONS	PTO USE ONLY		
				\$1000			
				Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).			
				Claims	Number Filed	Number Extra	Rate
				Total Claims	8- 20 =	0	x \$ 18.00
Independent Claims	1- 3 =	0	x \$ 80.00				
Multiple dependent claim(s) if Applicable)		0	+ \$270.00				
TOTAL OF ABOVE CALCULATIONS =				\$1000			
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28)							
SUBTOTAL =				\$1000			
Surcharge of \$130.00 for furnishing the English translation later than the <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$			
TOTAL NATIONAL FEE=				\$1000			
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31), \$40.00 per property +				40.00			
TOTAL FEES ENCLOSED=				\$1040			
				Amount to be refunded	\$		
				charged	\$		
a. <input checked="" type="checkbox"/> Two checks in the amounts of \$1000 and \$40 to cover the above fees are enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 23-1925 in the amount of \$ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23-1925. A duplicate copy of this sheet is enclosed.							
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.							
Send All Correspondence to: Brinks Hofer Gilson & Lione P.O. Box 10395 Chicago, IL 60610			Signature <i>Gregory H. Zayia</i> Name Gregory H. Zayia Registration Number P-48,059				

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Our Case No. 9683/81

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:)
)
Hideo Uchizono and Seiji Abe)
) Examiner: To be assigned
Serial No.: New Application)
) Group Art Unit No.: To be assigned
Filing Date: Herewith)
)
For ELECTRONIC DEVICE WITH USB)
INTERFACE)

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to examination of this application on the merits, please enter the following amendments and remarks.

IN THE CLAIMS

Please rewrite claims 2 and 3 as follows:

2. (Once Amended) An electronic device according to claim 1, wherein said USB transmitter-receiver includes an endpoint for a control transfer, and
wherein said controller receives, from said host computer, information specifying a desired logical device via said endpoint for a control transfer, and connects an endpoint selected from the endpoints of said USB transmitter-receiver to said logical device.
3. (Once Amended) An electronic device according to claim 1, wherein said USB transmitter-receiver includes an endpoint for a control transfer, and
wherein said controller receives, from said host computer, information specifying a desired service via said endpoint for a control transfer, and connects an

endpoint selected from the endpoints of said USB transmitter-receiver to a logical device corresponding to the said service.


SUPPORT FOR AMENDMENT

The amendments to claim 2 and 3 were made to correct typographical errors, and for clarification. No new matter has been added. Upon entry of this amendment, claims 1-8 are present and active in the application.

REMARKS

The changes in claims 2 and 3 rewritten by the present amendment relative to original claims 2 and 3 are shown in Appendix A (attached herewith), wherein bracketing is used to identify deleted material and underlining is used to identify added material. Applicants submit that the application is now ready for examination on the merits.

Respectfully submitted,



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APPENDIX A

2. (Once Amended) An electronic device according to claim 1, wherein said USB transmitter-receiver includes an endpoint for a control transfer, and

wherein said controller receives, from said host computer, information specifying a desired logical device via said endpoint [fora] for a control transfer, and connects an endpoint selected from the endpoints of said USB transmitter-receiver to said logical device.

3. (Once Amended) An electronic device according to claim 1, wherein said USB transmitter-receiver includes an endpoint for a control transfer, and

wherein said controller receives, from said host computer, information specifying a desired service via said endpoint [fora] for a control transfer, and connects an endpoint selected from the endpoints of said USB transmitter-receiver to a logical device corresponding to the said service.

DESCRIPTION

Electronic device with USB interface

5 TECHNICAL FIELD

The present invention relates to an electronic device with a USB interface.

BACKGROUND ART

10 The USB (Universal Serial Bus) is a bus for connecting a computer to various electronic devices. This USB is a cable bus that encompasses two signal lines and two power supply lines. Many personal computers and their peripheral devices have an interface conforming to the USB.

15 The USB interface was devised with a premise of a system in which one or a plurality of devices are connected to one host computer. These devices connected to the host computer via the USB are generally called USB devices.

20 When a USB device is connected to the host computer, the host computer assigns a unique address to the USB device. In addition, the USB device has a plurality of endpoints for terminating a communication between the USB device and the host computer. The host computer handles communication with these endpoints of the USB device.

25 A study is underway with regard to a compact portable electronic device with a plurality of functions. When connecting such a multifunctional portable electronic device to a host computer using a USB interface, it is necessary to provide a fixed endpoint for each function within the portable electronic device. However, the provision of such an endpoint for each function is not desirable in a portable electronic device that needs to be compact. There is also a situation that there is not such a great need to simultaneously use a plurality of functions in such portable electronic devices.

DISCLOSURE OF THE INVENTION

The present invention was made in consideration of the above-described situation, and has an object to provide an electronic device capable of providing a plurality of functions via a Universal Serial Bus(USB), using a small number of compact interfaces.

To achieve the above-noted object, the present invention provides an electronic
5 device having a USB transmitter-receiver with at least one endpoint performing a transfer of information via a USB, a device section including at least one logic device performing a transfer of information with a host computer via the USB transmitter-receiver, and a controller which, when the host computer uses a desired logical device in the device section, selects an endpoint required for a transfer of information between the logical
10 device and the host computer out of the endpoints within the USB transmitter-receiver and makes a connection to the logical device.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a configuration of a communication system
15 including a mobile device according to a first embodiment of the present invention.

Fig. 2 is a block diagram showing a configuration of a USB transmitter-receiver in the first embodiment of the present invention.

Fig. 3 is a sequence diagram showing the operation of the first embodiment of the present invention.

20 Fig. 4 is a sequence diagram showing the operation of the first embodiment of the present invention.

Fig. 5 is a block diagram showing a configuration of a communication system including a mobile device according to a second embodiment of the present invention.

25 Fig. 6 is a sequence diagram showing the operation of the second embodiment of the present invention.

Fig. 7 is a sequence diagram showing the operation of the second embodiment of the present invention.

Fig. 8A, Fig. 8B, and Fig. 8C are drawings showing another operational example in the second embodiment.

Fig. 9 is a sequence diagram corresponding to the operational examples of Fig. 8A, Fig. 8B, and Fig. 8C.

Fig. 10 is a block diagram showing a configuration of a communication system including a mobile device according to a third embodiment of the present invention.

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BEST MODE OF CARRYING OUT THE INVENTION

Preferred embodiments of the present invention are described below, with reference to the drawings.

[1] First Embodiment

10 [1.1] Configuration of the Embodiment

Fig. 1 is a block diagram of a communication system including a mobile device 1, which is a first embodiment of the present invention. As shown in Fig. 1, this communication system is formed by connection between the mobile device 1 and a host computer 2 by means of a USB cable 7. The mobile device 1, for example, is a multifunctional portable electronic device and has a USB transmitter-receiver 3, a controller 4, a device switcher 5, and a device section 6.

15

The USB transmitter-receiver 3 has three interfaces, I0 to I2. Each of the interfaces is assigned an interface number that can be identified within the USB transmitter-receiver 3, in this case the interface I0 numbered #0, the interface I1 numbered #1, and the interface I2 numbered #2. The interfaces I0 to I2 are described later in detail.

20

The USB transmitter-receiver 3 is connected to the controller 4 by the connection line 71, and connected to the device switcher 5 by the connection line 74.

The device section 6 has a plurality of logical devices 6-1 to 6-5, each logical device being connected to the device switcher 5 by the connection lines 75 to 79. These logical devices can be such devices as a voice communication device, a packet communication device, a telephone directory exchange device, an unlimited digital communication device, a printer, and a modem.

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The device switcher 5 is a selection switch that selects one of the connection lines 75 to 79, and connects the selected line with the connection line 74. For example, if the connection line 75 is selected, the host computer 2 can communicate with the logical device 6-1 via the USB transmitter-receiver 3, the connection line 74, and the connection line 75.

The controller 4 is connected to the device switcher 5 by the connection line 72 and connected to the device section 6 by the connection line 73. The controller 4 stores the following types of information:

- <1> a list of functions of the logical devices 6-1 to 6-5;
- <2> interface alternative setting values required for use of each logical device; and
- <3> information of the USB interface at the mobile device 1, such as the number of interfaces, the interface numbers, the number of endpoints, and the endpoint numbers

The controller 4 can notify the host computer 2 of the above-noted function information, via the USB transmitter-receiver 3 and the USB cable 7. The controller 4 receives an instruction of a desired function from the host computer 2 via the USB cable 7 and the USB transmitter-receiver 3, and can perform switching control for connecting to the host computer 2 a logical device within the device section 6 corresponding to that function. Details of this switching control are described later.

Fig. 2 is a block diagram showing the basic configuration of the USB transmitter-receiver 3.

In Fig. 2, the USB transmitter-receiver 3 shown is formed of three interfaces, I0 to I2. These interfaces I0 to I2 each has two endpoints (hereinafter abbreviated EP).

The EP is a basic unit making up the USB interface at the mobile device 1, and various types of EPs are used to accommodate various forms of data transfer. Each EP has a unique identification number (EP number) within the USB device (the mobile device 1 in this embodiment), by which each EP can be identified. Depending upon an interface, it is possible to treat a plurality of endpoints as a group.

The following description is with regard to the interfaces I0 to I2. In the description below, "IN" refers to the transfer direction from the USB device (mobile

device 1 in this embodiment) to the host computer, and "OUT" refers to the transfer direction from the host computer to the USB device.

(a) Interface I0

Interface I0 has endpoints EP0 and EP1, which have the following functions.

5 First, EP0 is an endpoint used for a control transfer. This is used in a setup that is performed when the USB device and the host computer are connected to each other to communicate. The setup performed using EP0 is described later in detail.

10 Next, EP1 is an endpoint used for an interrupt transfer. EP1 is used in an IN-direction interrupt transfer of various notifications from the USB device to the host computer.

(b) Interfaces I1 and I2

Interface I1 has EP2 and EP3, and interface I2 has EP4 and EP5.

15 EP2 to EP5 can be used for either a bulk transfer or an ISO (isochronous) transfer. It is also possible to switch a type of data transfer performed by these endpoints from a bulk transfer to an ISO transfer, and from an ISO transfer to a bulk transfer. Additionally, it is possible within an ISO transfer to perform switching of the data transfer amount.

The switching of the data transfer type among EP2 to EP5 is performed by using alternative settings of the interface.

In this embodiment, the alternative settings of the interface are defined as follows

20 Alternative setting 0. Bulk transfer IN/OUT mode (64 bytes)

Alternative setting 1. ISO transfer IN/OUT mode (8 bytes)

Alternative setting 2. ISO transfer IN/OUT mode (16 bytes)

Alternative setting 3. ISO transfer IN/OUT mode (32 bytes)

Alternative setting 4. ISO transfer IN/OUT mode (64 bytes)

25 Alternative setting 5. ISO transfer IN/OUT mode (128 bytes)

By means of the above-noted arrangement, it is possible for each interface to correspond to client applications.

[1.2] Operation of the Embodiment

Fig. 3 is a sequence diagram showing the setup procedure performed between the host computer 2 and the controller 4 of the mobile device 1 when the mobile device 1 is connected to the host computer 2 by the USB cable 7.

5 The host computer 2, when it detects the connection of the mobile device 1 (step S1), sends a reset signal, via the USB cable 7, to the USB transmitter-receiver 3 within the mobile device 1 (step S2). The USB transmitter-receiver 3 of the mobile device 1 receives this reset signal and sends it to the controller 4. The controller 4, by receiving this reset signal, is initialized, thereby enabling it to respond to a transaction. When the resetting of the mobile device 1 in this manner is completed, a default pipe is formed
10 between the host computer 2 and EP0 in the mobile device 1, enabling a control transfer via the default pipe.

The host computer 2 then starts setting-up the mobile device 1. First, the host computer 2 starts a control transfer with EP0 of the mobile device 1. At the setup stage of this control transfer, the host computer 2 transmits a Get Descriptor so as to request a
15 device descriptor (step S3). Next, the controller 4 of the mobile device 1 at the data stage of the control transfer sends the device descriptor to the host computer 2 (step S4). The host computer 2 in the status stage of the control transfer sends a length 0 data packet addressed to the EP0 of the mobile device 1, thereby notifying that the descriptor has been received normally (step S5).

20 The device descriptor sent to the host computer 2 in this manner has general information with regard to the mobile device 1. This general information includes such information as a protocol code of the mobile device 1 and the maximum packet size of the EP0.

When the host computer 2 receives this device descriptor, it assigns a unique
25 address (hereinafter referred to as the device address) to the mobile device 1 (step S6). After the host computer 2 completes the assignment of the device address, it sends a Set Address command to the mobile device 1, thereby reporting thereto of the device address (step S7). By doing this, the device address is set at the mobile device 1 (step S8).

After the device address setting is completed, the host computer 2 again sends Get Descriptor to the controller 4 of the mobile device 1 in the setup stage, to request the configuration descriptor from the controller 4 (step S9). When it receives the Get Descriptor, the controller 4 in the data stage sends a configuration descriptor to the host computer 2 (step S10). The host computer 2 in the status stage sends a length 0 data packet addressed to EP0, thereby giving notification that the descriptor was received normally (step S11).

The configuration descriptor sent to the host computer 2 from the controller 4 in this manner includes the following information among the information stored in the controller 4.

<1> A bit map table including a functional list of the logical devices 6-1 to 6-5 within the mobile device 1, which, by receiving, enable the host computer 2 to learn the functional configuration of the logical devices 6-1 to 6-5 within the mobile device 1.

<2> Information about the USB interface at the mobile device 1, such as the number of interfaces, the interface numbers, the number of endpoints, and the endpoint numbers.

After receiving this configuration descriptor, the host computer 2 learns the relationship between each endpoint number and the interface numbers, and sets the configuration of the mobile device 1 in the following manner. (step S12).

First, the host computer 2 initializes information regarding the EP and the interface configuration of the mobile device 1 stored in a memory, not shown. Here, the alternative settings are set 0 for both I1 and I2.

The host computer 2 subsequently performs an initialization of information with regard to a logical device to be used. When doing this, the host computer 2 does not specify which logical device to use among the logical devices 6-1 to 6-5 within the mobile device 1, but performs an initialization of information with regard to the logical devices so that, when a logical device to be used is subsequently determined, the setting can be changed accordingly.

Next, the host computer 2 in the setup stage of the control transfer sends Set Configuration (step S13), thereby making a request to perform setting of functions of the

interface as they were set at the step S12. The controller 4 of the mobile device 1, in response to this Set Configuration command, performs the setting of the interface (step S14).

Thus, the setup of the mobile device 1 is completed.

5 Fig. 4 is a sequence diagram showing an operation in a case that a request to use one of the logical devices is made from the host computer 2. In this sequence, the host computer 2 is supposed to use the logical device 6-1.

First, the host computer 2 starts a control transfer addressed to EP0 of the mobile device 1, and in the setup stage thereof sends Select_Service (step S101). This
10 Select_Service is a command requesting for a desired service. Next, the host computer 2, in the data stage, sends data that specifies a logical device within the mobile device 1 corresponding to the requested service to the mobile device 1 (step S102). When the controller 4 thus receives a notification message regarding the requested service and also a notification message that the device to be used is the logical device 6-1, in the status stage,
15 it notifies to the host computer 2 that the data was received normally (step S103).

Next, the controller 4 makes a judgment as to whether the logical device 6-1 is available or not (step S104). If at this point the logical device 6-1 is not available, the controller 4, by means of an interrupt transfer using the interface I0 (EP1), sends a Request_Acknowledge, which includes the information to that effect, to the host
20 computer 2 (step S105). By doing this, at the host computer 2, the user is notified of the refusal of the requested service, and the processing is terminated.

In contrast to the above, if the logical device 6-1 is available, the controller 4, by means of an interrupt transfer using the interface I0 (EP1), sends a Request_Acknowledge, which includes the information to that effect, to the host
25 computer 2 (step S106). Next, the controller 4 outputs a command to the device switcher 5 to the effect that a connection should be made between the connection line 75 corresponding to the logical device 6-1, for which the use was requested, and the connection line 74. When this command is received, the logical device switcher 5 makes a connection between the connection line 74 and the connection line 75 (step S107).

At the host computer 2, when the Request_Acknowledge indicating the availability of the logical device 6-1 is received, in the setup stage of the control transfer, a request is made to the mobile device 1 for an interface alternative setting value corresponding to the logical device 6-1, which is to be used (step S108).

- 5 When this request for the alternative setting value is received, the controller 4 of the mobile device 1, in the data stage, sends the interface alternative setting value required for using the logical device 6-1 to the host computer 2 (step S109).

- 10 Upon receiving this alternative setting value, the host computer 2 notifies the mobile device 1, in the status stage, to the effect that the transmission has succeeded (step S110).

 Upon receiving this alternative setting value, the host computer 2 makes a judgment as to whether, in receiving the service, the alternative interface setting value notified by the mobile device 1 can be left as it is (step S111).

- 15 If there is no problem with the alternative setting value as a result of the judgment at step S111, a buffer area corresponding to EP2 to EP5 of the mobile device 1 is formed, comparable to a host buffer, and a pipe is formed between the host buffer and each of the EPs of the mobile device 1. After that, the host computer 2 starts communication corresponding to the requested service between itself and the connected logical device 6-1 of the mobile device 1 (step S118).

- 20 If the alternative interface setting value is not satisfactory as a result of the judgment at step S111, the host computer 2, in the setup stage of control transfer with EP0 of the mobile device 1, sends Set Interface, thereby making a request to the controller 4 to switch the alternate setting of each EP (steps S112 and S115). On receiving this Set Interface command, the mobile device 1 first gives notification in the status stage that the request transmission has succeeded (steps S113 and S116), after which the alternative settings of each interface are switched, each EP being set to the status corresponding to those alternative setting values (steps S114 and S117).
- 25

 For example, if the service to be used is an ISDN communication service, for a Q921/Q931 communication, an interface (for example, interface I1) is set to the

alternative setting 0 for bulk transfer, and for a B channel communication, another interface (for example, interface I2) is set to the alternate setting 2 for ISO transfer. Thus, it is possible to perform data communication on two channels. However, if a data transfer capacity of 32 or more bytes is required for an ISO transfer, the alternate setting would be in the range 3 to 5. For this reason, in this example the host computer 2 would make a request to switch the interface I2 alternative setting to a value from 3 to 5, and when this request is received, the controller 4 switches the alternative setting of the interface I2.

In this manner, when the switching of the alternative settings of each interface is completed, a pipe is formed between the host buffer and the EP. The host computer 2 then starts communication corresponding to the requested service, between itself and the connected logical device 6-1 of the mobile device 1(step S118).

When a voice communication device or a modem is used as the logical device 6-1, it is sufficient to have one pair of EPs for IN/OUT. For this reason, it is possible to use the desired logical device, using one interface instead of two.

Thus, it is possible to reduce the number of EPs according to the mobile device 1 of this embodiment, because it is sufficient to have one USB interface for a plurality of logical devices.

The following variation of this embodiment can be envisioned. Specifically, at step S10 of the setup operation as shown in Fig. 3, the alternative interface setting values required for the use of each logical device are sent from the mobile device 1 to the host computer 2 for all logical devices within the mobile device 1. If this is done, in the sequence shown in Fig. 4, in which the host computer is to use a desired logical device, it is possible to omit the process (steps S108 and S109) for the host computer 2 to receive the alternative value for the logical device to be used from the mobile device 1.

[2] Second Embodiment

[2.1] Configuration of the Embodiment

Fig. 5 is a block diagram showing the configuration of a communication system including a mobile device 1A according to a second embodiment of the present invention. In this drawing, parts corresponding to parts in Fig. 1 are assigned the same reference

numerals. In this communication system, the mobile device 1A has number of ports. Each of these ports is not a physically independent transmission path, but rather corresponds to a communication channel that joins the host computer 2 and the mobile device 1A. All of the ports physically use a single USB cable.

- 5 One or a plurality of TE (terminal equipment)s are connected to the host computer 2. Each TE can be a standalone hardware that is physically independent from the host computer 2, and can alternatively be an application software installed in the host computer 2. Each TE can select one of the ports in the mobile device 1A and can use a logical device within the mobile device 1A via this port.

- 10 The internal configuration of the mobile device 1A in this embodiment is described below. The USB transmitter-receiver 3 of the mobile device 1A is made up of interface blocks 3-1 to 3-n corresponding to n number of ports and an endpoint EP0 shared by all the ports for a control transfer. The interface blocks 3-k (where k=1 to n) have interfaces I0, I1, and I2. The interface I0 has EP1, the interface I1 has EP2 and EP3, and the
15 interface I2 has EP4 and EP5. The functions of each endpoint are as described with regard to the first embodiment.

The interfaces I1 and I2 of the interface blocks 3-k corresponding to each port are assigned identifiers ID0 and ID1 each for identifying thereof among the ports.

- Each of the interfaces is assigned an interface number that can be identified in the
20 USB transmitter-receiver 3: the interface I0 of the interface block 3-1 being #0, the interface I1 of the interface block 3-1 being #1, the interface I2 of the interface block 3-1 being #2, the interface I0 of the interface block 3-2 being #3, and so on.

- The device switcher 5 is formed by switches SW1 to SWn, corresponding to the n number of ports. Switches SWk corresponding to each port connects an interface block
25 3-k to one of the logical devices within the USB device 6. Which logical device is to be connected to the interface block 3-k is controlled by the controller 4.

A function manager 8 is a means to monitor how each logical device 6-k (where k=1 to m) is used within the USB device 6 and to manage the available logical devices for every port. In a case of the configuration shown in Fig. 5, when no logical devices are

being used, in using any of the ports, it is possible to select and use a desired logical device among all the logical devices

[2.2] Operation of the Embodiment

The operation of this embodiment is discussed below.

5 When the mobile device 1A is connected to the host computer 2 by the USB cable 7, initialization by a prescribed procedure is performed both at the mobile device 1A and the host computer 2. In this initialization, the host computer 2 assigns one address to the mobile device 1A. At the mobile device 1A, the alternative settings of all interfaces are set to 0. A descriptor is sent from the mobile device 1A to the host computer 2.

10 This descriptor includes the following two pieces of information for each port.

a. Lists of available functions by each port

In the configuration shown in Fig. 5, each of the functions of the logical devices 6-1 to 6-n would be sent as a list of available functions for each port. Instead of making all the logical devices available for each port, logical devices used at each of the ports may
15 be different from one another, in which case a separate function list is sent for each port individually.

b. The number of interfaces and their alternative settings for the ports

By receiving these data, the host computer 2 can learn the correspondence, for each port, between interface numbers and endpoints used at each interface, as shown in
20 the example below.

<Example>

25	Port 1	Interface number 1	EP1
		Interface number 2	EP2
		Interface number 2	EP3
		Interface number 3	EP4
		Interface number 3	EP5
	Port 2	Interface number 4	EP6
		Interface number 5	EP7
		Interface number 5	EP8

Interface number 6	EP9
Interface number 6	EP10
(Further entries omitted)	

5 Assuming that a TE is connected to the host computer 2, the operational sequence of this embodiment is as shown in Fig. 6.

In this case, the TE connected to the host computer 2 gives notification to the host computer 2 of the functions supported by the TE (step S201). Next, the TE selects one of the ports (for example, the port k) at the mobile device 1A.

10 Next, the host computer 2 starts a control transfer with the EP0 within the mobile device 1A and, in the setup stage thereof, sends Put_TE_Capability (step S202). This Put_TE_Capability is a command giving notification of the services that the TE might use, and an interface number corresponding to the port k selected by the TE is included therein. Next, the host computer 2, in the data stage, sends data to the mobile device 1A that indicates the service that the TE might use (step S203).

15 Next, the controller 4 of the mobile device 1A, in the status stage, sends notification to the host computer 2 that the transmission of the Put_TE_Capability and the data following thereafter succeeded (step S204).

20 Next, the controller 4 is notified by the interface number in the command received at step S202, of that the port selected by the TE is port k, and inquires of the function manager 8 as to whether it is possible, using the port k, to use a logical device corresponding to the service which notified at step S203. In a case that the port k can be used so as to use the logical device corresponding to the service, an interrupt transfer using the interface I0 corresponding to port k is used to send a Request Acknowledge to the host computer 2 (step S205).

25 Next, referring to the operational sequence shown in Fig. 7, the operation of this embodiment up until the TE receives the service by the logical device within the mobile device 1A is described below.

First, the TE requests a desired service from the host computer 2 (step S301). Upon receiving this request, the host computer 2 performs a control transfer to the EP0

within the mobile device 1A. In this control transfer, in the setup stage, Select_Service is sent (step S302). This Select_Service includes one of the interface numbers corresponding to the port k used by the TE. Next, in the data stage, data that specifies the service requested at step S301 is sent (step S303).

5 Next, the controller 4 of the mobile device 1A, in the data stage, gives notification to the host computer 2 that the service request transmission has succeeded (step S304).

 Next, the controller 4 of the mobile device 1A makes a judgment, based on the interface number in the command received at step S302, as to whether the TE is using port k and inquires of the function manager 8 as to whether it is possible to use the logical
10 device corresponding to the service which notified at step S303 at port k or not. In a case in which it is possible to use the logical device corresponding to the requested service, the controller 4 sends a command to the switch SW_k corresponding to the port k, so as to connect the logical device to the interface block 3-k which corresponds to the port k (step S305).

15 The controller 4 then performs an interrupt transfer using the interface I₀, corresponding to the port k, to return a Request Acknowledge to the host computer 2 (step S306).

 Next, the controller 4, in the interrupt transfer using the interface I₀ corresponding to the port k, sends Notify_Interface_Number, which includes the identifiers and interface
20 numbers of each interface used in the service, to the host computer 2 (step S307).

 Next, the host computer 2, makes a judgment as to whether, in receiving the service via the port k, it is necessary to perform alternative settings for each interface or not. If it is necessary, a control transfer addressed to the EP0 within the mobile device 1A is started and, in the setup stage thereof, Set_Interface is sent for the purpose of making
25 alternative settings (step S308). This Set_Interface includes an interface number of the interface for which an alternative setting is to be made and an alternative setting value specifying a type of data transfer, an amount of data that can be transferred, and the like.

 When the controller 4 of the mobile device 1A receives the Set_Interface, it performs an alternative setting corresponding to the alternative setting value within the

received information for the interface corresponding to the interface number within the received information (step S308). The controller 4 also notifies the host computer 2 that the transmission of the Set_Interface succeeded (step S309). By doing this, communication corresponding to the requested service is started between the TE and the logical device within the mobile device 1A connected to the port k at step S305 (step S310).

Another operational example of this embodiment is discussed below. In this embodiment, it is possible to use logical devices in a form illustrated in Fig. 8A to Fig. 8C. First, as shown in Fig. 8A, a first TE is connected to the logical device 6-1 via the port 1, and the first TE starts to use the logical device 6-1. Next, as shown in Fig. 8B, a second TE is connected to the logical device 6-2 (for example, a voice communication device) and the second TE starts to use the logical device 6-2. Next, it becomes necessary for the second TE to be switched to FAX communication and, as shown in Fig. 8C, the device connected to the port 2 is changed from the logical device 6-2 to, for example, the logical device 6-3.

Fig. 9 is a sequence diagram showing the communication exchanged between each TE, the host computer 2, and the mobile device 1A in the above-described operational example. In Fig. 9, steps S301 to S310 are the sequence up until the condition shown in Fig. 8A, this procedure having already been described with reference to Fig. 7.

Steps S311 to S319 are the sequence up until the condition shown in Fig. 8B. In this sequence, the second TE, which has previously selected the port 2, requests for voice communication to the host computer 2 so as to connect the logical device 6-2 (voice communication device) to the port 2 between the host computer 2 and the mobile device 1A (steps S312 to S319). These procedures have already been described with reference to Fig. 7.

Steps S321 to S329 show the procedure up until the condition shown in Fig. 8C. The switching from voice communication to FAX communication is performed by control transfer by switching the device connected to the port 2 to the logical device 6-3

(steps S322 to S325) and changing the interface alternative setting to a setting corresponding to FAX communication (step S328).

In this manner, it is possible to switch the device connected to the port 2 without influencing the port 1.

5 Furthermore, while this embodiment is described for the case in which the host computer 2 makes notification of a desired service to the mobile device 1 and a logical device suitable for the service is selected at the mobile device 1, it is alternatively possible to have the host computer 2 specify a logical device for the mobile device 1.

[3] Third Embodiment

10 Fig. 10 is a block diagram showing the configuration of a communication system including a mobile device 1B according to a third embodiment of the present invention. In this drawing, parts corresponding to parts in Fig. 5 are assigned the same reference numerals. In this embodiment, EP0 for a control transfer is provided in interface I0 for every port. For this reason, the host computer 2, when performing a setup, performs a
15 control transfer via the EP0 with respect to all ports. The host computer 2 regards that each port is an independent device, and assigns an address to each port of the mobile device 1B. Thus, in this embodiment it is possible to perform the same type of operation as in the first embodiment for each port individually. For this reason, the host computer 2 can simultaneously access to the logical devices 6-1 to 6-mas many as the number of
20 ports (1 to n), and can perform communication corresponding to the service requested by the TE. The mobile device 1B can cause logical devices to simultaneously operate in response to a service request from the host computer 2.

CLAIMS

1. An electronic device comprising:

a USB transmitter-receiver having one or more endpoints for sending and receiving information via a universal serial bus;

5 a device section including one or more logical devices for sending and receiving information to/from a host computer, via said USB transmitter-receiver; and

a controller which, when said host computer uses a desired logical device in said device section, selects an endpoint required for sending and receiving information between said logical device and said host computer from the endpoints within said USB

10 transmitter-receiver and makes connection to said logical device.

2. An electronic device, wherein said USB transmitter-receiver includes an endpoint for a control transfer, and

wherein said controller receives, from said host computer, information specifying a desired logical device via said endpoint for a control transfer, and connects an endpoint
15 selected from the endpoints of said USB transmitter-receiver to said logical device.

3. An electronic device, wherein said USB transmitter-receiver includes an endpoint for a control transfer, and

wherein said controller receives, from said host computer, information specifying a desired service via said endpoint for a control transfer, and connects an endpoint selected
20 from the endpoints of said USB transmitter-receiver to a logical device corresponding to the said service.

4. An electronic device according to claim 1, wherein said USB transmitter-receiver performs an interrupt transfer with said host computer via an endpoint for an interrupt control in said USB transmitter-receiver, thereby setting a function of an endpoint used in
25 sending and receiving information between said logical device and said host computer.

5. An electronic device according to claim 1, wherein said USB transmitter-receiver has a plurality of interfaces formed by one or more endpoints, and one of these interfaces includes an endpoint for a control transfer; and

wherein said controller receives information specifying said desired logical device from said host computer via said endpoint for a control transfer, selects an interface required for sending and receiving information with said host computer from among the interfaces of said USB transmitter-receiver, and makes connection to said logical device.

- 5 6. An electronic device according to claim 1, wherein said USB transmitter-receiver has an endpoint for a control transfer and a plurality of interface blocks corresponding to a plurality of ports, and each interface block has a plurality of interfaces formed by one or a plurality of endpoints, and

10 wherein, when said host computer receives a desired service via a desired port, said controller receives information specifying said desired service from said host computer via said endpoint for a control transfer, and connects an interface block corresponding to said port within said USB transmitter-receiver to a logical device corresponding to said service.

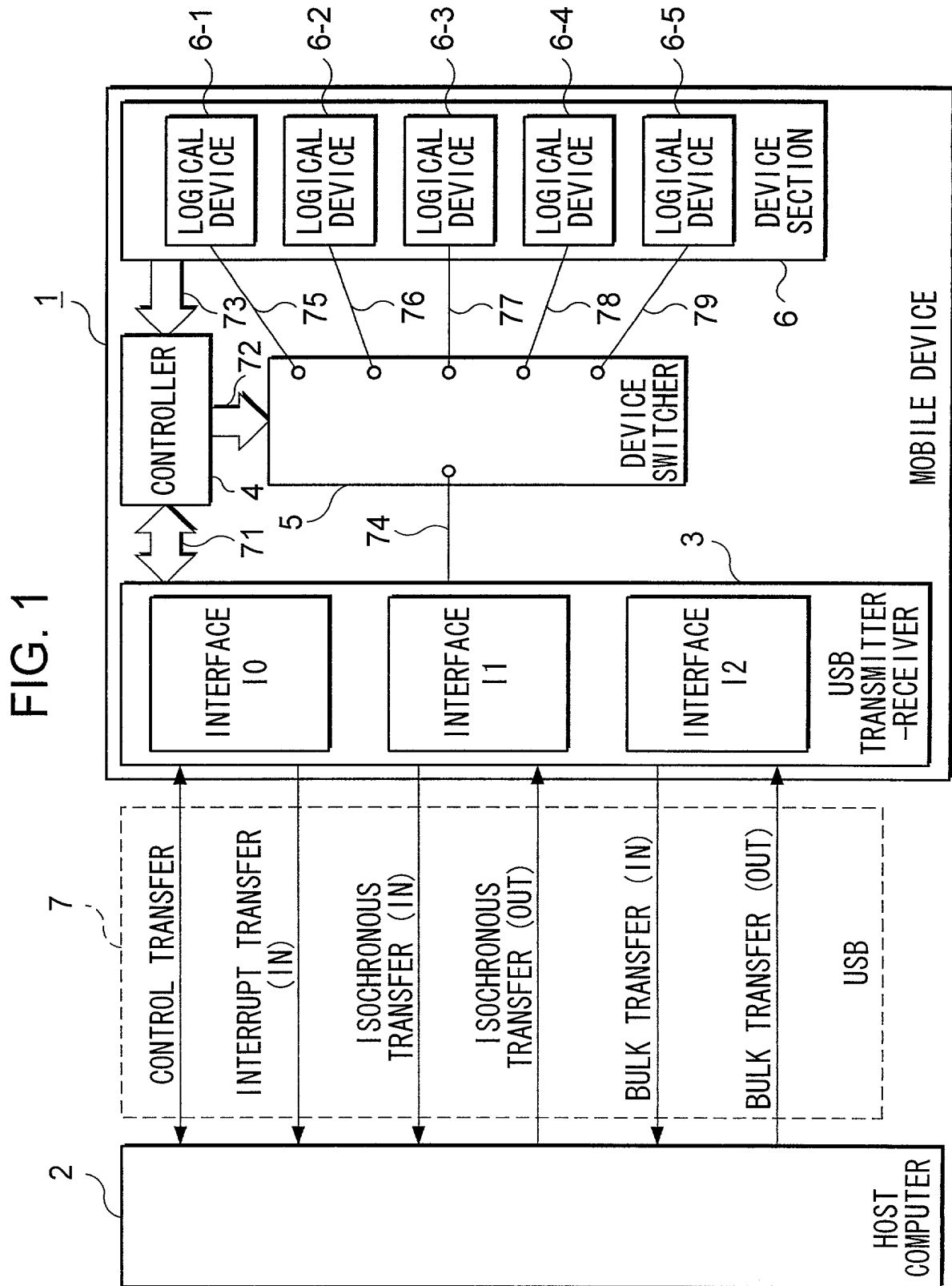
- 15 7. An electronic device according to claim 6, wherein when said host computer requests to receive a different service from another port while using a certain logical device via a certain port, said controller connects an interface block corresponding to said another port to a logical device corresponding to said different service.

- 20 8. An electronic device according to claim 1, wherein said USB transmitter-receiver has a plurality of interface blocks corresponding to a plurality of ports, each said interface block has a plurality of interfaces each formed by one or a plurality of endpoints, and one interface of said interfaces includes an endpoint for control transfer; and
wherein, when said host computer receives a desired service via a desired port, said controller receives, from said host computer, information specifying said desired service via said control transfer endpoint, which is included in an interface block corresponding to
25 said desired port in said USB transmitter-receiver, and connects a logical device corresponding to said service to an interface block corresponding to said port within said USB transmitter-receiver.

ABSTRACT

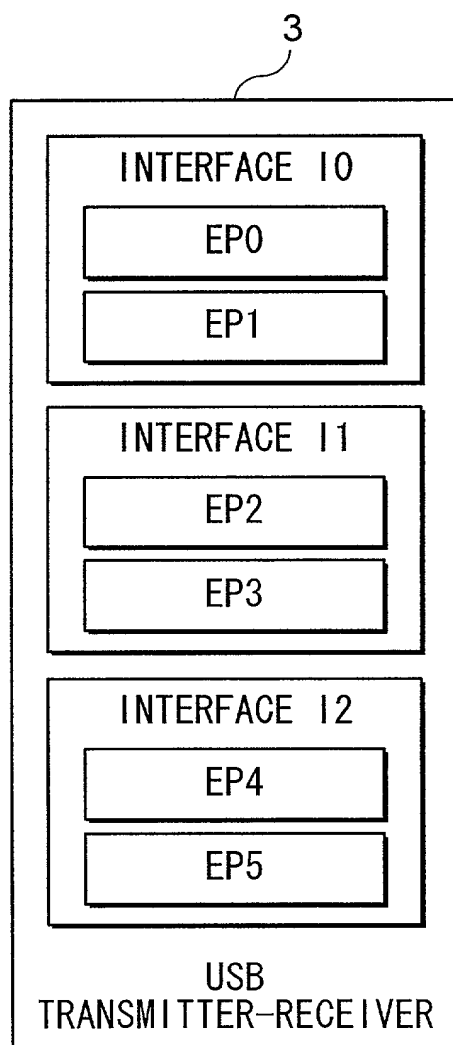
A mobile device 1 has a USB transmitter-receiver 3 having one or more interfaces formed by one or more endpoints for exchanging information via the USB, one or more logical devices 61 to 65 performing the exchanging of information with a host computer 2 via the USB transmitter-receiver, and a controller 4 which, when a function of one or more logical devices is used, selects as many interfaces as required for the exchange of information between the logical device and the host computer 2 from the one or more interfaces within the USB transmitter-receiver.

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FIG. 2



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FIG. 3

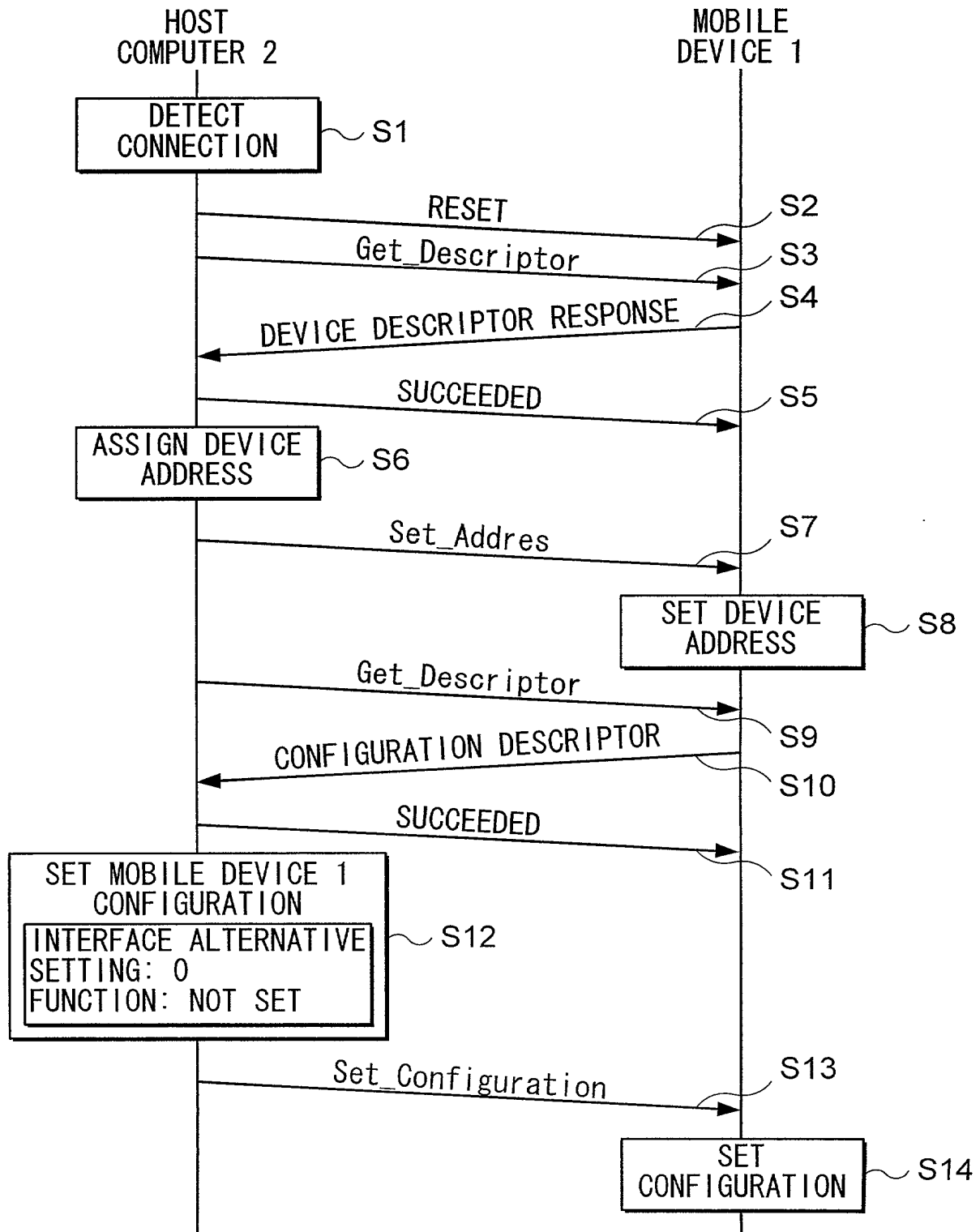


FIG. 4

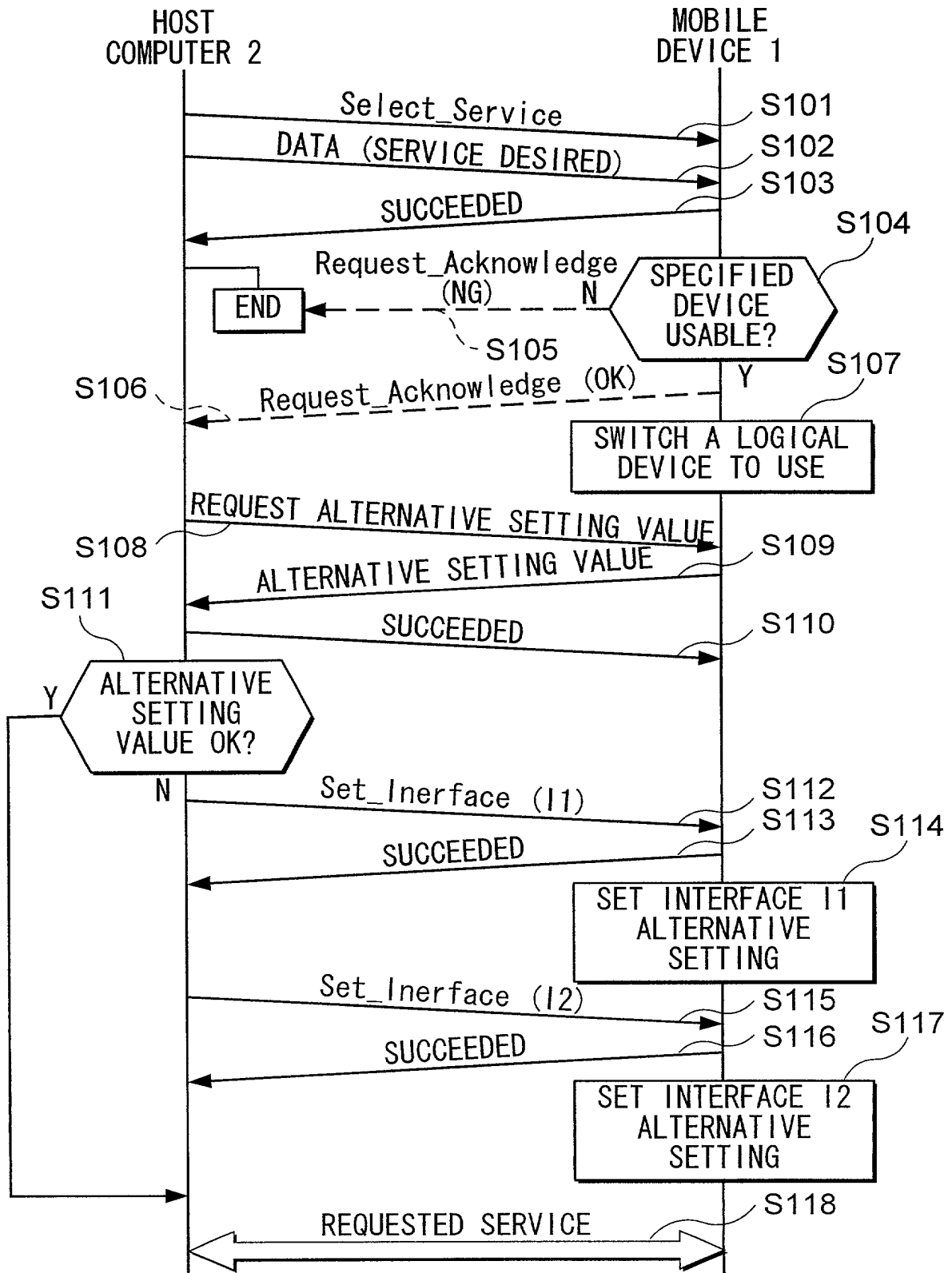
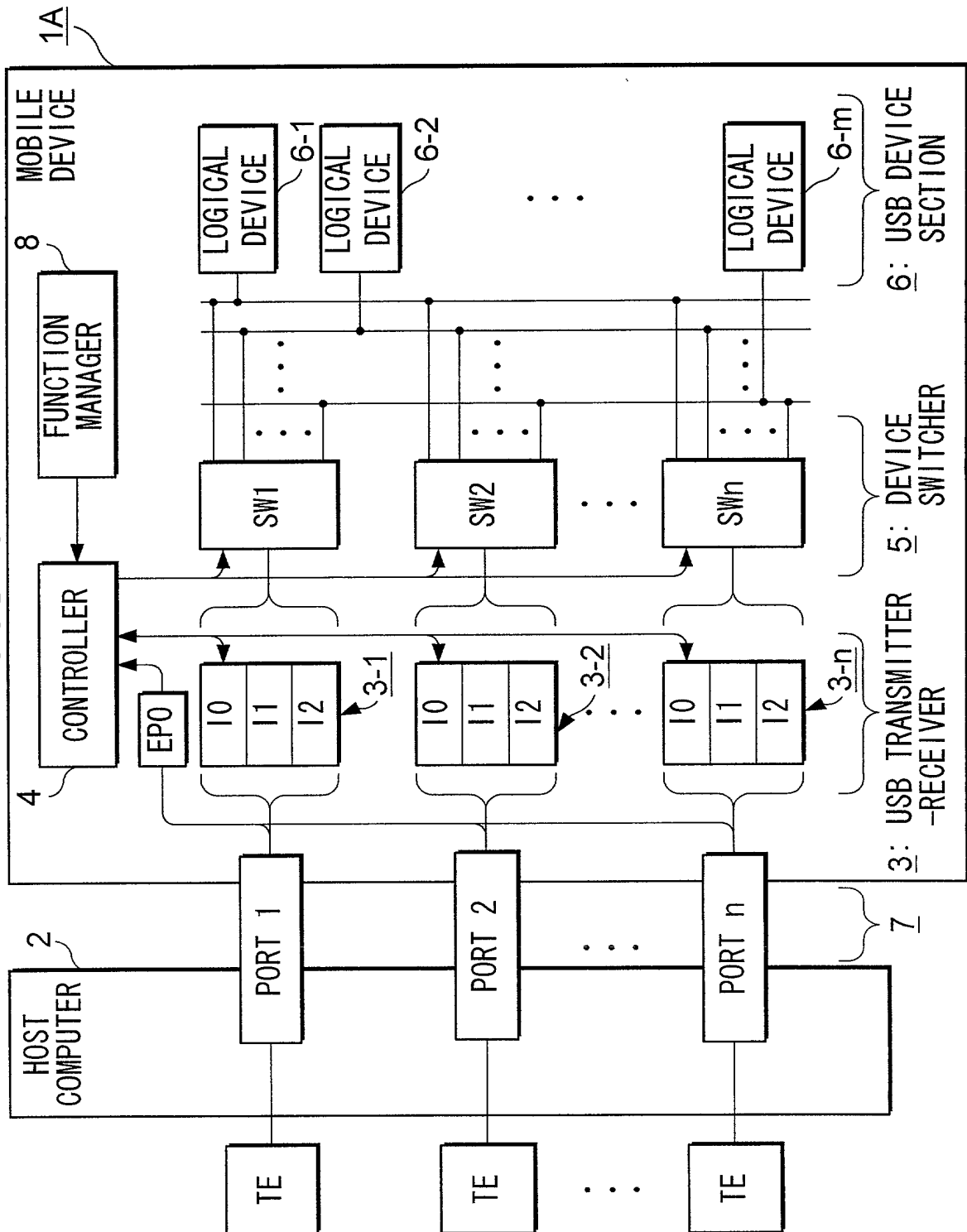


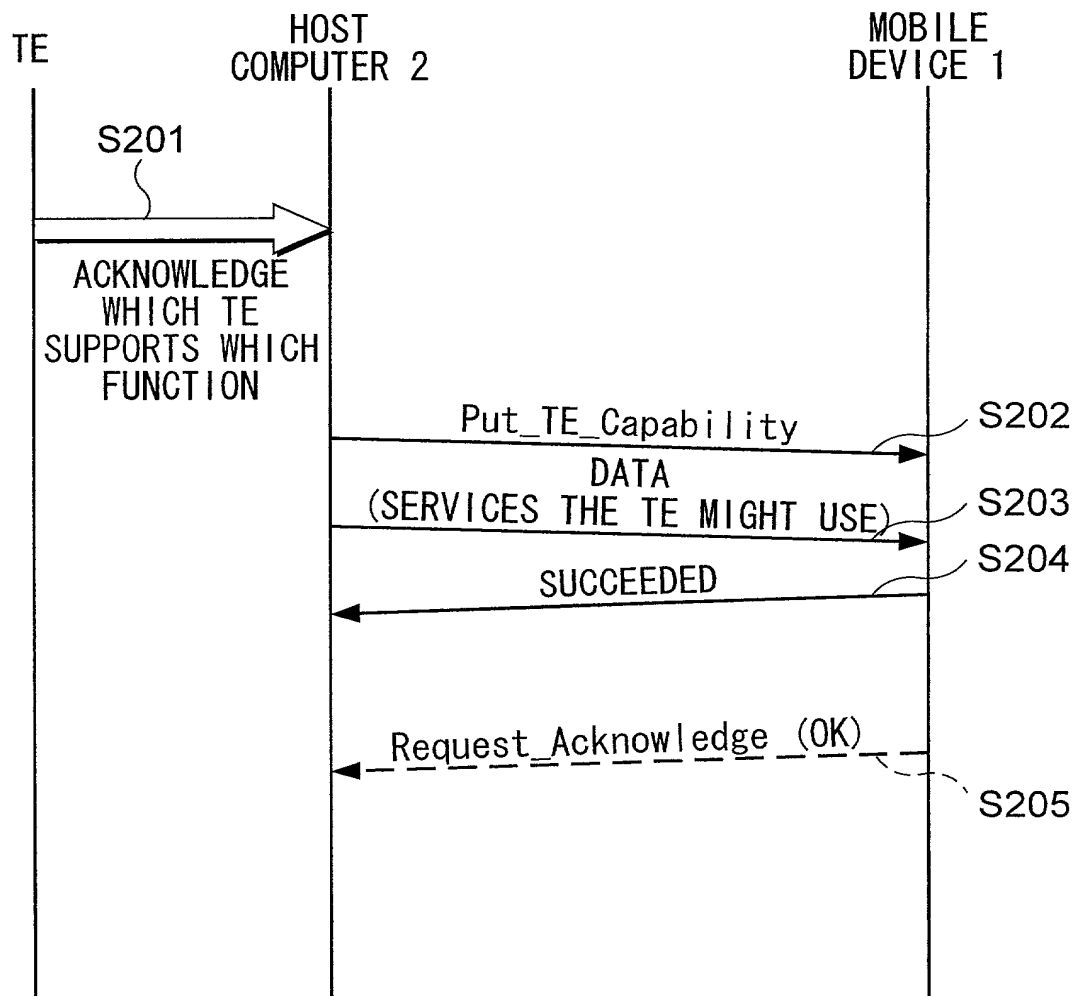
FIG. 5



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FIG. 6



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FIG. 7

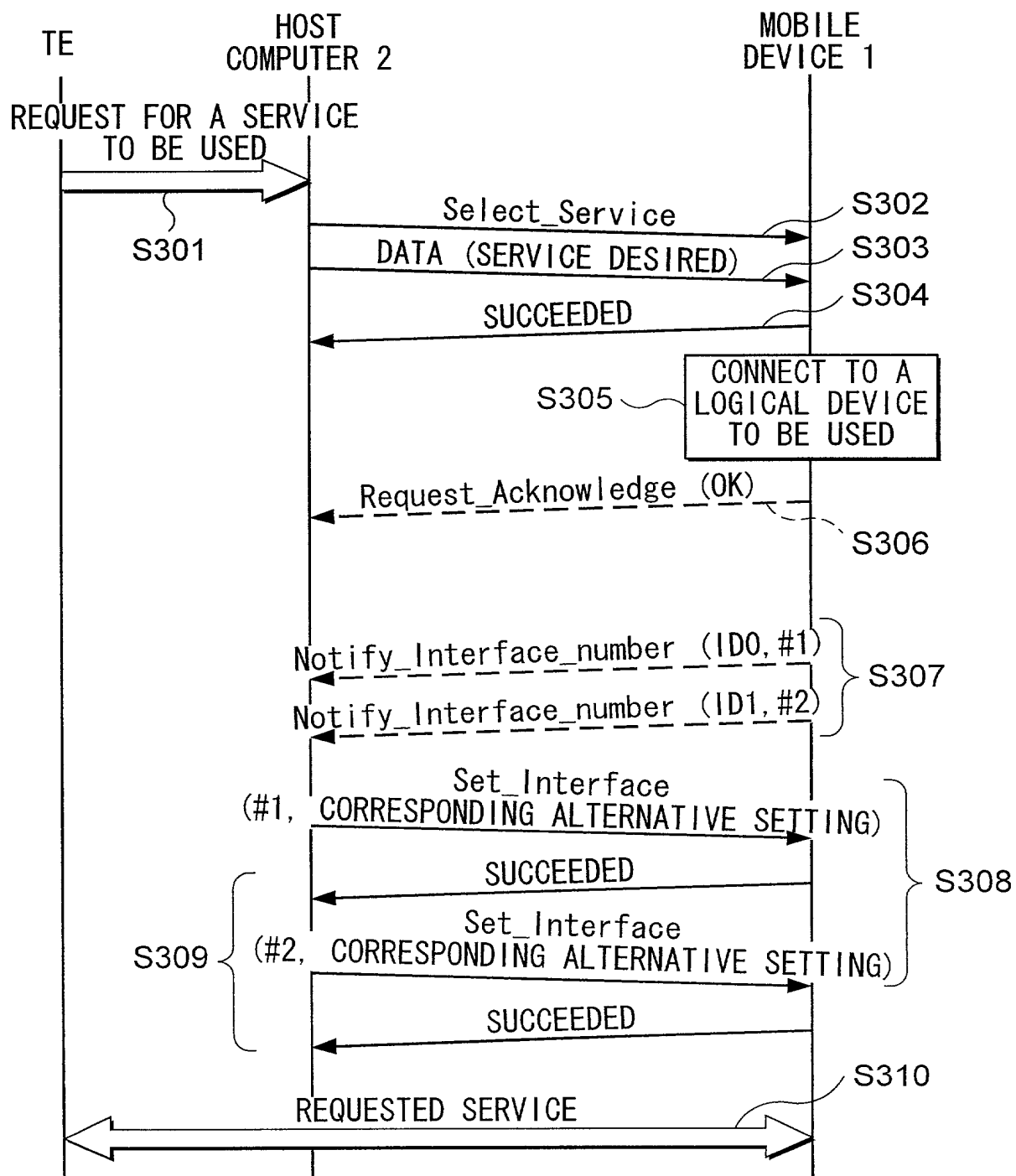


FIG. 8A

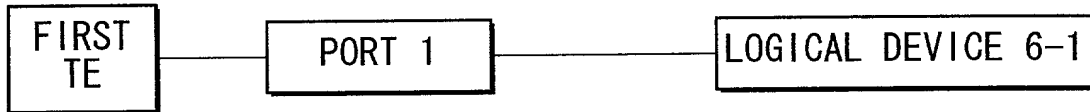


FIG. 8B

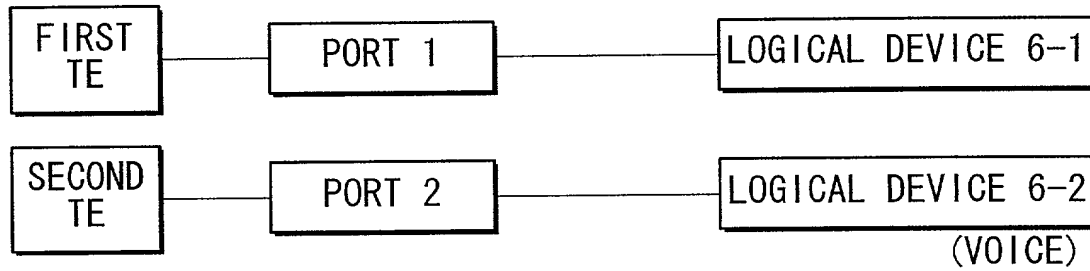
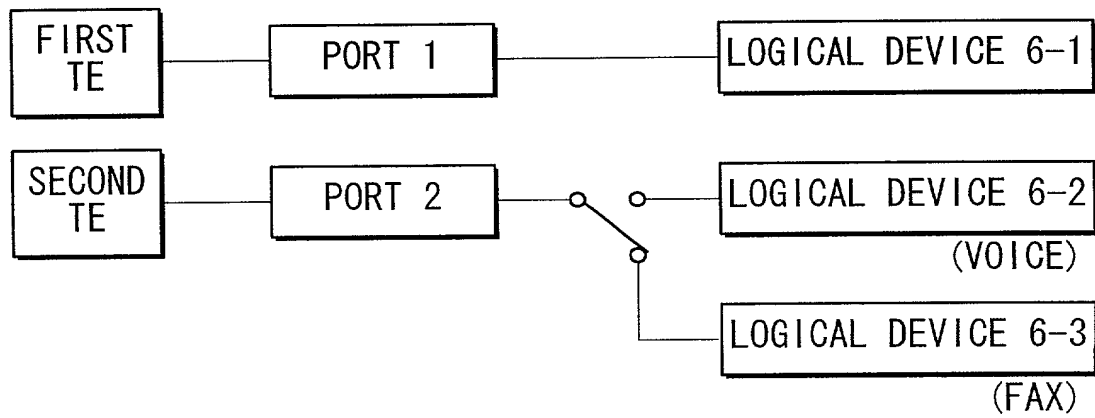
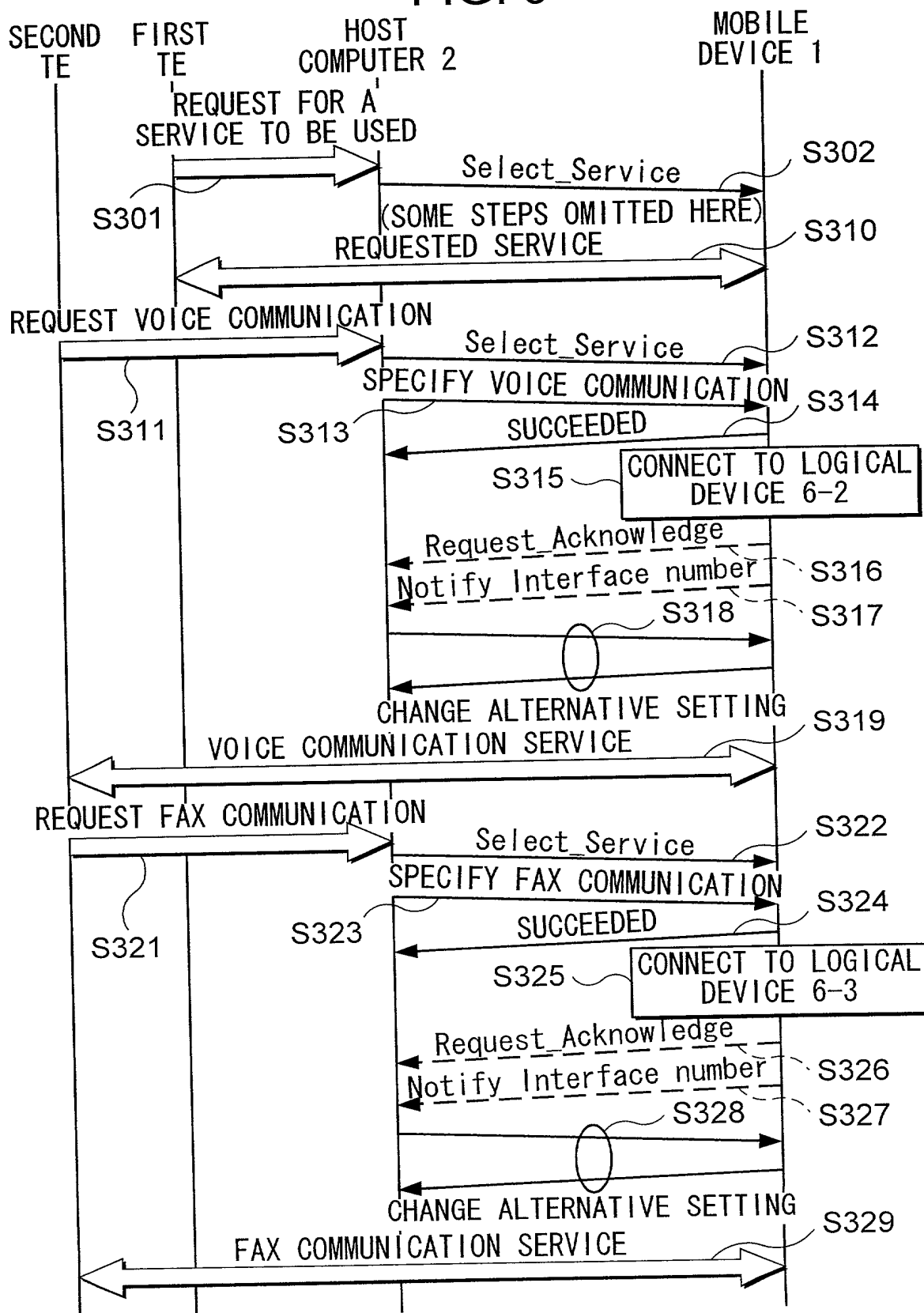


FIG. 8C



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FIG. 9



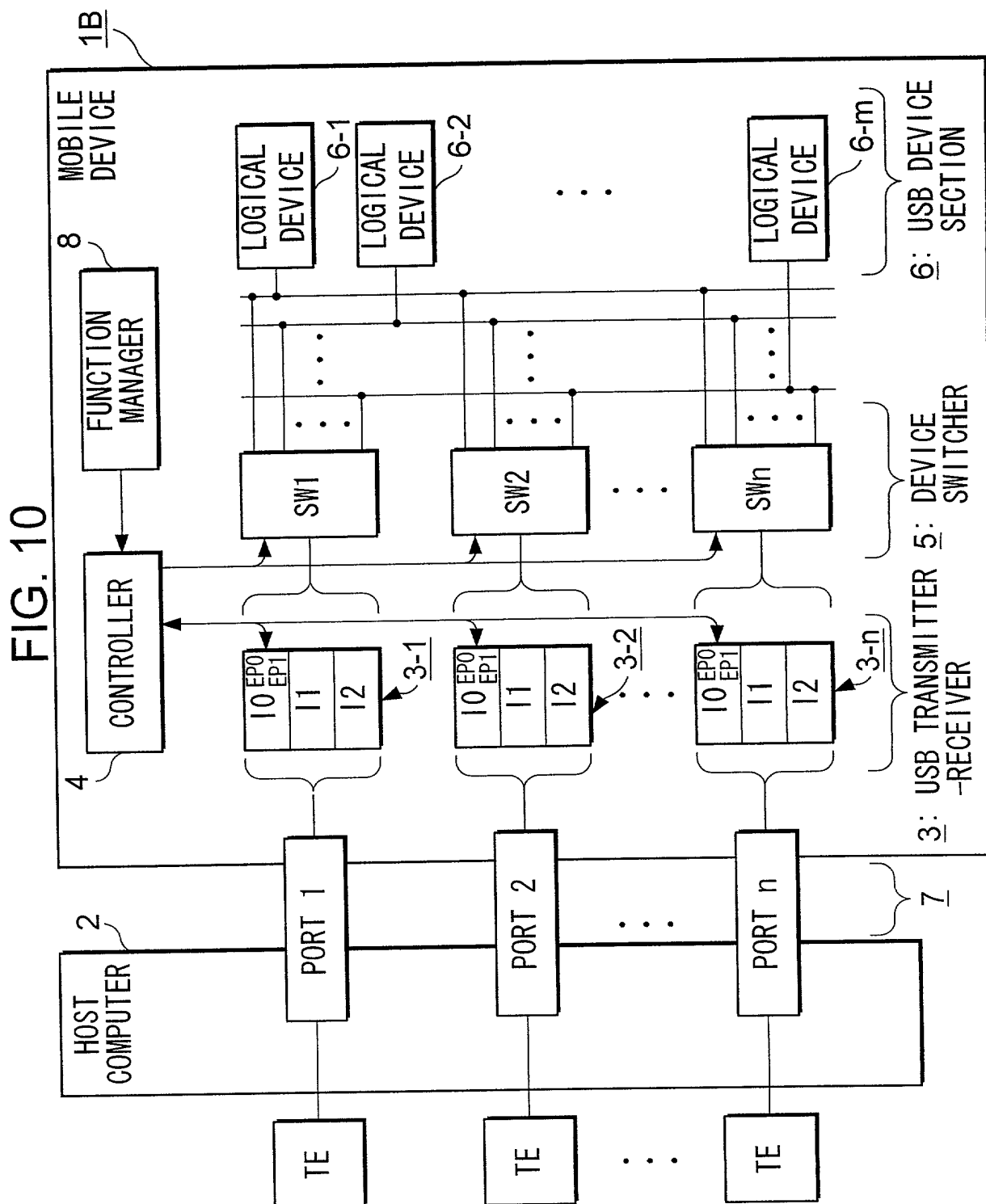


Figure 1 consists of 12 bar charts arranged in a single column. Each chart represents a different demographic or marital status category. The x-axis for all charts represents age groups: 18-24, 25-34, 35-44, 45-54, 55-64, and 65+. The y-axis represents the percentage of respondents, ranging from 0 to 100. The categories are: 1. Total, 2. Male, 3. Female, 4. White, 5. Black, 6. Hispanic, 7. Asian, 8. Pacific Islander, 9. Other, 10. Married, 11. Single, and 12. Divorced. The charts show varying trends across age groups, with some categories showing a steady increase or decrease, while others show more complex patterns.

My residence, post office address and citizenship are as stated below next to my name.

☐ is attached hereto.

☒ was filed on 4 August, 2000 as International Application No. PCT/JP00/05241.

☐ and was amended on _____ (if applicable).

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Hei 11-224701	Japan	06/08/99	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

(Application Serial No.)	(Filing Date)
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<u>PCT/JP00/05241</u>	<u>04/08/00</u>	<u>Pending</u>
(Application Serial No.)	(Filing Date)	(Status-patented, pending, abandoned)

Date: January 24, 2001

Inventor's Signature

Full name of second inventor 2 - 00

Residence

Citizenship

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Inventor's Signature

Full name of third inventor

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Citizenship

Post Office Address

Date:

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Inventor(s): Hideo UCHIZONO, et. al.
Title: Electronic Device with USB Interface

POWER OF ATTORNEY

The specification of the above-identified patent application:

- ☐ is attached hereto
☒ was filed on 4 August, 2000 as International Application No. PCT/JP00/05241

I hereby revoke all previously granted powers of attorney in the above-identified patent application and appoint the following attorneys to prosecute said patent application and to transact all business in the Patent and Trademark Office connected therewith:

Gustavo Siller, Jr. - 32,305
Tadashi D. Horie - 40,437

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Brinks Hofer Gilson & Lione
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Chicago, IL 60610
(312)321-4200

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OR
☐ An assignment from the inventor(s) of the patent application identified above. The assignment was recorded in the Patent and Trademark Office at Reel _____, frame _____.
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1. From _____ To: _____
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 2. From _____ To: _____
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☐ Additional documents in the chain of title are listed on a supplemental sheet.

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I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements, and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signature: Yoshitaro Shimanuki Date: February 1, 2001
Name: Yoshitaro SHIMANUKI
Title: Executive Manager
Intellectual Property Department